Docket No.: (C049105/0225758)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Marcus Brian Mayhall Fenton et al.	)	
Serial No.: 10/590,527	)	Examiner: S. Cernoch
Filed: August 24, 2006	)	Art Unit: 3752
For: **METHOD AND APPARATUS FOR GENERATING A MIST**	)	

Commissioner for Patents
Washington, D.C. 20231

DECLARATION OF MARCUS BRIAN MAYHALL FENTON, PH.D.

UNDER 37 CFR §1.132

I, Marcus Brian Mayhall Fenton, Ph.D. a citizen and resident of Great Britain, hereby declare as follows:

1. I received a BEng mechanical engineering (with honors) with a specialty in thermodynamics and fluid mechanics from the University of Huddersfield in 1988. I received a MSc in mechanical engineering (research) with a specialty in fluid flow system analysis models from the University of Warwick in 1992. I received a Ph.D. in mechanical engineering from Warwick University in 1994. My Ph.D. work included a detailed analysis of the oil flow and heat transfer processes within an engine lubrication system.

2. From 1994-2001, I was employed by Federal-Mogul Technology Ltd., which was the European automotive research and engineering center for the Federal Mogul Corp. During this time, I served in positions with progressively more

responsibility. For example, as Manager – Verified Predictive Analysis, a position I held from 1999-2001, I supervised the use of leading edge engineering, computational analysis, instrumentation, and testing to provide greater insight into the fluid, heat, and structural properties and behavior of the company's products.

3. I have been employed by Pursuit Dynamics PLC ("Pursuit") directly or through one of its subsidiaries continuously since 2001. Over the last approximately 10 years, I have served, first as Pursuit's Technology Manager, and more recently as Chief Scientific Officer. My duties during this time have been focused in the area of developing new and improved fluid processing and atomization products and applications/solutions for the company. .

4. Specifically, from approximately mid 2003 to 2005, I led the initial development of the first variants of our atomization technologies. From approximately 2005 to 2008, I led teams at Pursuit in developing next-generation nozzles designs. Since approximately early 2009, I have supervised all R&D at Pursuit and its subsidiaries. A copy of my *Curriculum Vitae* is attached as Exhibit 1.

5. I am a co-inventor of the present application identified in the caption above. The present application discloses and claims, *inter alia*, an apparatus for generating a mist. The apparatus includes a conduit having a mixing chamber and an exit and a means for creating a dispersed droplet flow regime in which a substantial portion of the droplets have a size of less than 20 micrometers. The means includes a working fluid inlet in fluid communication with the conduit to introduce a working fluid into the conduit and a transport nozzle in fluid communication with the conduit to introduce a transport fluid into the mixing chamber. The transport nozzle includes a

convergent-divergent portion therein to provide for the generation of high velocity flow of the transport fluid. The transport nozzle and conduit have a relative angular orientation at the mixing chamber for the introduction of transport fluid flow from the transport nozzle into working fluid flow from the conduit and for shearing of the working fluid by the transport fluid. (*See, e.g.*, Specification, p. 1, para. 14 – p. 2, para. 24; Figures 9-14; and Claims 1-6, 8-12, 14, 15, 19-22, and 28).[1/] Spray systems that include such an apparatus are also disclosed and claimed (*See, e.g.,* Specification, p. 11, para. 236 – p. 13, para. 269; and Claims 35-38). Methods of generating a mist using such an apparatus are also disclosed and claimed. (*See, e.g.,* Specification, p. 2, para. 49 – p. 3, para. 81; p. 4, para. 108; Figures 9-14; and Claims 39, 41-44, 46, 47, 49-52, and 56-60).

6. In the present invention, it has been demonstrated that the apparatus, systems, and methods provide a substantial portion of the droplets with a size less than 20 micrometers and which droplets have sufficient momentum to project a sufficient distance and to, *e.g.*, penetrate into the heat of a fire. (Specification, p. 10, paras. 220-221). Based on these observations, a significant advance is achieved by proceeding in accordance with the presently claimed apparatus, systems, and processes to produce a mist that may be used, *e.g.*, for fire suppression (p. 12, para. 247), decontamination (p. 13, para. 266), or gas scrubbing (p. 13, para. 269).

7. About 95% of droplets achieved using an apparatus according to the present invention have a size (diameter) of less than 10-20 micrometers. Moreover, the droplet diameters achieved also have a tight uniform distribution between 4-6

1/ For convenience, citations to the specification herein are to the published U.S. patent application (US2008/0230632).

micrometers. (*See*, *e.g.*, Figure 23). As a consequence, a mist generated using an apparatus of the present invention has a number of advantages including, *e.g.*, the ability to reach non line-of-sight areas, the ability to increase the rate of cooling of a fire, and the ability to attach to hydroscopic nuclei suspended in, *e.g.*, the gasses of a contaminated space, causing the nuclei to become heavier and to fall to the floor, where they are more manageable, particularly in decontamination applications. Thus, the invention provides novel apparatus, systems, and methods for generating a mist with improved, highly advantageous properties.

8. I am aware that an Office Action has issued with regard to the present application. It is my understanding that in the Office Action, the Examiner asserted, *inter alia*, that the claimed apparatus, systems, and methods are not patentably distinct in view of certain alleged prior art documents. (Paper No. 2010070 at 4-12).

9. I am also aware that in the currently pending Office Action, there are two art-based rejections. (Paper No. 2010070 at 4-11 and 12). I am familiar with Rummel and Pennamen cited in both rejections. Based on my understanding of Rummel and Pennamen, as set forth in more detail below, I believe that the rejections misconstrue Rummel and Pennamen in at least the following ways: first, Rummel does not disclose a transport nozzle that includes a convergent-divergent portion and second, Pennamen does not disclose a droplet size of less than 20 micrometers.

Rummel

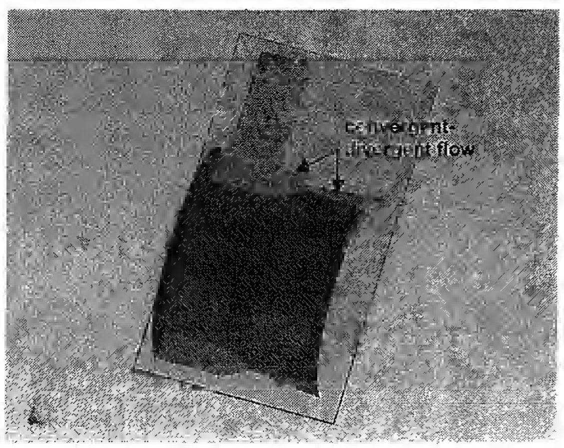
10. Rummel discloses a nozzle for foaming, spraying, or misting. The nozzle is principally used to foam cement, although other uses, such as fire extinguishing, are briefly mentioned. (p. 4, para. 50). Generally, Rummel discloses a nozzle that includes a housing with an annular component. The annular component includes ducts for feeding a second medium, *e.g.*, a gas, a first inlet for feeding a medium to be foamed (*e.g.*, cement), and an outlet. (p. 5, para. 75). The ducts are disclosed to be configured as round bores to permit optimum flow conditions. (*Id.*, para. 79 and Figure 1).

11. In the Office Action, the Examiner focused on Rummel's Figure 5. In Figure 5, the ducts are disposed in the annular component and are formed obliquely with respect to the main flow direction of the media to be mixed (*i.e.*, cement) within the annular component. The ducts are arranged in two separate groups. The ducts of one group are aligned obliquely in the opposite direction of the other group. The axes of the ducts form an acute angle α with the main flow direction and accomplish foaming or mixing due to the oblique entry of the second medium (*i.e.*, a gas).

12. Rummel's description of the ducts in Figure 5 – and, indeed, in all of the Figures – indicate that they are straight-sided bores with no special shaping, which would be required if a convergent-divergent nozzle shape were desired. Even if one were to look at the ducts in combination with the annular chambers of Rummel, it is my understanding that what is happening is that the flow is passing from an annular cross-section into a series of holes or passageways. This, again, is not a convergent-divergent shape.

13. As shown below, under my supervision, a CAD model was generated to show the flow pattern of the device depicted in Figure 5 of Rummel, which is contrasted with a CAD model of the flow pattern of a portion of an apparatus within the scope of, *e.g.*, claims 1 and 39 of the above-identified application:

Claims 1/39



Rummel, Fig. 5

14. As indicated by the arrows in the left panel above showing an apparatus within the scope of claims 1 and 39, the transport nozzle has a convergent-divergent portion. In contrast, as indicated by the arrows in the right panel above, the ducts in Figure 5 of Rummel are aligned obliquely and arranged in opposing pairs. This

is consistent with the full disclosure of Rummel in which there is no recitation of "convergent", "divergent" or "high velocity flow".

15. In sum, based on my knowledge and experience, and in view of the results of the CAD modeling presented herein, it is my opinion that one cannot view Rummel as disclosing or suggesting the use of a transport nozzle with a convergent-divergent portion as recited in the claims that are pending and under examination in the above-identified application.

Pennamen

16. Pennamen discloses methods and apparatus for atomizing a heavy, highly viscous liquid, such as, *e.g.*, an oil, to achieve good combustion of the oil. The Pennamen apparatus contains a head with a plurality of primary channels, the atomization orifices of which are regularly distributed on the head of the device in the form of a circular ring or in the form of two coaxial circular rings. (Col. 3, lns. 25-30). According to Pennamen, the apparatus is able to achieve atomization of, *e.g.*, oil, into "fine droplets of very small diameter, of the order of 100 thousandths of a millimeter." (Abstract; Col. 1, lns. 25-27). According to Pennamen, to obtain droplets of this size, the viscosity of the product must be less than 20 mm^2/s at the atomization temperature. (Col. 1, lns. 27-30).

17. When Pennamen was filed, for highly viscous liquids, such as oils, with a viscosity of 4,000 mm^2/s at 100°C, the atomization temperature had to be high – between about 200°-230°C – in order to reduce the viscosity of the product to about 20 mm^2/s to achieve good atomization by conventional methods. (*Id.* at 30-34).

Pennamen provides two examples. (Col. 5, ln. 1 – Col. 6, ln. 2). In both examples, Pennamen's apparatus is able to atomize highly viscous liquids, such as oils, at considerably lower temperatures compared to conventional methods. (*Id.*). For the specified conditions, including an oil viscosity of 200 mm^2/s at 20°C, the apparatus was able to atomize the highly viscous fluid into droplets having a Sauter mean diameter at the exit of "35 microns, with 90% of the droplets having a diameter of less than 120 microns and 99% of them having a diameter of less than 290 microns." (Col. 5, lns. 25-28; Col. 5, ln. 66 – Col. 6, ln. 2).

18. I understand that the Examiner has used the statement in Pennamen that to achieve good combustion of, *e.g.*, highly viscous oil, it must be atomized into fine droplets "of the order of 100 thousands of a millimeter" to reject the current claims, which recite, *inter alia*, that "a substantial portion of the droplets have a size of less than 20 micrometers." (Paper No. 20100707 at p. 4). In making this rejection, I understand the Examiner to interpret "100 thousands of a millimeter" to be equivalent to 10 nanometers (and thus less than 20 micrometers). (*Id.* at pp. 12-13). For the reasons set forth below, it is my belief that the Examiner is incorrect.

19. My understanding of the expression "100 thousandths of a millimeter" is best explained by expressing it arithmetically:

$$\text{100 thousandths of a millimeter} = \frac{100}{1{,}000}\text{ millimeter}$$

$$= \frac{1}{10}\text{ millimeter}$$

$$= \left(\frac{1}{10}mm\right)\times 1000\frac{\mu m}{mm}$$

= **<u>100 μm (micron)</u>**.

Thus, mathematically, the expression "100 thousandths of a millimeter" is equivalent to 100 micrometers (or microns). Thus, my understanding of Pennamen is that the disclosed apparatus is able to generate droplets of, *e.g.*, oil "of the order of" 100 microns.

20. My understanding is confirmed by <u>all</u> of the Pennamen examples. (*See*, *e.g.*, Col. 5, ln. 1 – Col. 6, ln. 2). As noted above, the Examples show the Sauter mean droplet size at the exit from the device was "35 microns, with 90% of the droplets having a diameter of less than 120 microns and 99% of them having a diameter of less than 290 microns", which is "of the order of" 100 microns. My understanding is also supported by <u>all</u> of the Pennamen claims that recite a droplet diameter. In every such claim (*see*, *e.g.*, claims 1, 3, 9, and 10), the recited Sauter mean droplet diameter is "of about 35 microns, with at least ninety percent of said droplets having a droplet diameter of less than 120 microns and ninety-nine percent of said droplets having a droplet diameter of less than 290 microns."

21. After reviewing Pennamen, I can find <u>no</u> data to support the Examiner's assertion that the Pennamen apparatus is able to produce droplets on the order of "10 nanometers". Indeed, all of the droplet diameter data are several orders of magnitude larger than the "10 nanometers" asserted by the Examiner (0.01 micrometers vs. 100 micrometers).

22. As a further matter of mathematics, I cannot agree with the Examiner's interpretation of Pennamen. As I noted above, in the Office Action, the Examiner asserts that the expression in Pennamen of "100 thousandths of a millimeter"

is equivalent to $\frac{1}{100,000}$ millimeter. That is incorrect as a matter of mathematics. The fraction "$\frac{1}{100,000}$" is expressed linguistically as "1 hundred thousandths". Thus, the Examiner appears to have mistakenly added a "1" in front of "100 thousandths" to arrive at his interpretation.

23. Furthermore, as a matter of common usage, I cannot agree with the Examiner's interpretation of Pennamen. For example, in an on-line article posted April 11, 2001 entitled "The Advantages of Fog Humidification Systems" by Joanna R. Turpin (a copy of which is attached as Exhibit 2), the author describes the diameter of a typical water fog nozzle as "between 75 and 100 thousandths of an inch." (p. 2). I note the author throughout the article uses the common convention in this art of stating a range from the smallest end point to the largest end point. Thus, it is clear the author means the diameter of a typical water fog nozzle is between $\frac{75}{1,000}$ to $\frac{100}{1,000}$ of an inch. If one were to apply the Examiner's interpretation of Pennamen to the Turpin article, the range would be stated from the larger end point ($\frac{1}{75,000}$) to the smaller end point ($\frac{1}{100,000}$). Such a usage simply defies common convention.

24. In sum, based on my knowledge and experience, and after a careful review of Pennamen, it is my opinion that the expression "100 thousandths of a millimeter" is equivalent to 100 micrometers (or microns).

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and

further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated: 4 February 2011

Marcus Brian Mayhall Fenton, Ph.D.

EXHIBIT 1

CURRICULUM VITAE

Dr Marcus B M Fenton

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Eaton Socon
St Neots
Cambridgeshire
PE19 8BP

Date of Birth; 25/03/66 Nationality; British

KEY SKILLS

- **Qualified, skilled and experienced Engineer and Manager with an excellent track record.**

Educated to PhD level and with over 16 years industrial experience leading advanced Research and Development. A specialism in fluid mechanics and thermodynamics and the application of this science for the development of new products and solutions in a commercial environment. Founder member of the technical team at Pursuit Dynamics since the company was formed in 2001. Responsible for the research and development of the company's core technology and leveraging the strength of this technology to provide step change improvements in a wide range of application areas in numerous industry sectors.

CAREER HISTORY

2001 – Present **Chief Scientific Officer, Pursuit Dynamics plc. Cambridgeshire, UK**

The company was formed in 2001 initially to develop and commercialise a new marine propulsion technology which used steam to accelerate a water stream. Having joined the company in 2001 as part of the core team of only six people, I was responsible for growing the R&D team and for the development of this new technology.

My key roles within the company include;

Technology development – Managed the key R&D projects to develop the core Reactor and atomiser technologies and application solutions, which enabled the company to penetrate into new application areas. The successful outcome of these 'high risk' new application projects lead to the step-change PDX technology becoming established in a many industry sectors, including food and drink, brewing, waste water, oil and gas, decontamination, and fire suppression. Project management responsibilities included project planning, costing, customer management and communication, financial tracking, trials planning, and managing resources. The majority of these projects involved the management and running of small scale evaluation tests at Pursuit Dynamics laboratories, and both small and large scale proving and pre-production trials at customers' sites around the world.

Resource management – This involved the recruitment and development of key personnel, the development of the infrastructure required for R&D, instrumentation and testing, design and analysis, and prototype and production manufacturing. This included the building of the design and Computational Fluid Dynamics (CFD) team, and the management of the development of in-house numerical models and unique CFD tools to model the complex behaviour of a multiphase flow (incorporating phase change).

Managing the liaison with industry and academia - This included multiphase numerical modelling and CFD analysis which was undertaken in close collaboration with several leading Universities.

IP management – Developed the company's IP protection strategy and conducted the day to day management of patents and trademarks. This included drafting and filing patents and managing their development through the international patent process. This was a key role within the company, with IP forming the backbone of the company's strategy and protection as it emerged into new markets.

HS&E management– Responsible for the HS&E requirements for the company.

1994 – 2001 **Federal-Mogul Technology Ltd, Rugby, Warwickshire**

Federal-Mogul Technology was the European automotive research and engineering centre for the $7bn Federal-Mogul Corporation. The role of the company was to bring forward new products and processes to keep Federal-Mogul at the leading edge of automotive components and systems suppliers.

1999 – 2001 **Manager – Verified Predictive Analysis**

The Verified Predictive Analysis (VPA) group provided a powerful alliance between predictive state-of-the-art computational analysis techniques and advanced instrumentation and engine testing. Reporting directly to the Managing Director I was responsible for a team of over 30 Engineers, Mathematicians, Programmers and Technicians, plus the management of the facilities required to support the group. The role of my department was to use utilise leading-edge engineering, computational analysis, instrumentation and testing to provide a greater insight into the fluid, heat and structural properties and behaviour of the company's products, leading to the development of improved products. My main achievements included;

- Working in partnership with all the Federal-Mogul businesses, negotiating, planning and delivering solutions to their immediate and future R&D Defining a strategy with them for their future technology development direction.
- Recruiting, training and leading a world class Design, Finite Element (FE), CFD and numerical modelling team.
- Development of an advanced Noise Vibration and Harshness (NVH) team. A FE analysis and instrumentation team dedicated to understanding the fundamental mechanisms of brake and power cylinder system NVH.
- Developing the facilities to support the CAE and NVH teams. I specified, budgeted and implemented a UNIX and NT network to run the core software, which included ProE, ProMechanica, ABAQUS, Nastran, Patran, FamBuild, Hypermesh, StarCD, CFX, Catia and SDRC Ideas.
- Maintaining financial control inline with the Company's and the Group's expectations. For example, I budgeted and managed an IT budget which exceeded £400k, and a capital budget exceeding £500k.
- Specified and managed a £250k upgrade to the engine test cells and developed dedicated automated test rig cells.
- Initiated, budgeted and planned a new £6m state-of-the-art Engine Technology Centre.
- Implemented the installation of a SLA rapid prototyping facility to support my novel concept team.
- Maintaining world class standards of production and quality. Acquired ISO9001 accreditation.
- Strict adherence to, and implementation of, HS&E Regulations.

1997 – 1999 **Department Manager – Structural Analysis and Process Modelling**

Responsible for the recruitment and development of approximately 10 analysts and numerical modellers, many of which were world leaders in their fields. As a Department Manager, I had Project Management responsibility for the department's projects. Advanced analysis techniques were developed for all Federal-Mogul product groups, including pistons, pins, rings, liners, con-rods, bearings, gaskets, valve train, brakes, chassis components, heat shields and vibration control products. Key development areas included;

- Thermofluid R&D using CFD analysis, including world leading complex 2 phase piston oil cooling, Gerotor port oil flow, and under-hood heat shield performance.
- The development of unique in-house analysis tools, such as an in-cylinder cycle simulation code, and a complete engine design/analysis framework.
- The development of the company's hardware and software strategy.
- FE analysis of complex automotive systems. E.g. the power cylinder system, the block/head/gasket set, and the brake system.
- Worked in partnership with 3rd party companies. E.g. worked closely with Safe Technologies to develop an advanced strain life fatigue prediction tool, and HKS to develop the ABAQUS gasket element.
- Worked in partnership with several Universities to develop unique analytical tools and material models. E.g. the powder material model used for the simulation of the powder compaction process.

1994 – 1997 **Project Manager and Thermofluid Analyst – Engineering Analysis Department**

Working within the Engineering Analysis department utilising CFD and FE tools for the analysis of automotive components. Main achievements include;

- Development of advanced CFD techniques for analysing brake rotor air-cooling, radiator air flow and heat transfer, and Gerotor oil port flow.
- Key member of the brake rotor development team, providing structural and thermal CFD and FE analysis.
- Project Management of a £200k collaborative project with PSA to develop a unique brake rotor design with improved air flow cooling and structural performance.
- Patent author for a number of novel brake rotor designs.
- Project Management of a £300k collaborative project with Lucas-Varity, modelling brake roughness.
- Excellent knowledge of software tools ProE, ProMechanica, FamBuild, ABAQUS and StarCD.

1986 – 1987 **Industrial placement – UK Ministry of Defence (RARDE Chertsey) – Military Tracked vehicles**

Responsibilities included project management of a number of military vehicle systems projects.

EDUCATION

1990 - 1994 PhD Mechanical Engineering. University of Warwick, Coventry, UK
Research sponsored by Jaguar Cars. A detailed analysis of the oil flow and heat transfer processes within an engine lubrication system. This included the development of a unique numerical model to provide a thermofluid design/analysis tool for use by engine designers.

1990 - 1992 MSc Mechanical Engineering (Research). University of Warwick, Coventry, UK
Fluid flow system analysis model. Submitted at the end of the first year of the PhD.

1984 - 1988 BEng Mechanical Engineering (Hons.), with specialist modules in Thermodynamics and fluid Mechanics. 1st Class. University of Huddersfield, UK. Final year project for the UK Ministry of Defence.

EXHIBIT 2

The Advantages of Fog Humidification Systems

by Joanna R. Turpin

Posted: April 11, 2001

These days, everyone is concerned over indoor air quality and occupant comfort. Proper humidification is always right up there at the top of the list when talking about either concern. The tricky part is deciding which system to use. There are numerous types of humidification equipment out there, and not every one is right for every situation.

One of the many types of systems available is fog humidification, or fogging systems. These systems are not designed for use in residential or small applications; they work best in larger commercial/industrial buildings. Due to the low energy costs involved with fogging systems, they are becoming increasingly popular.

In one type of fog humidification system, high-pressure water is forced through special stainless steel nozzles which atomize the water into billions of superfine fog droplets. And superfine means just that — some nozzles generate more than five billion superfine drops per second, and these droplets measure in the range of 10 microns dia.

How Fogging Works

This type of high-pressure fogging system consists of a high-pressure pump, which delivers clean water at 1,000 to 2,000 psi to a series of fog nozzles, which are usually installed in air ducts or in the air-handling unit. A typical fog nozzle has an orifice diameter of five to seven thousandths of an inch. Water jets out of the orifice and hits the impaction pin, which breaks the water stream up into the billions of superfine fog droplets.

These fogging systems are generally controlled by a solenoid valve that turns on the fog nozzles. The speed of the high-pressure pump can also be more closely controlled with a variable-frequency drive, although this tends to raise the cost a bit more. Sometimes the controls can become a little challenging, notes John Mee, marketing manager, Mee Industries Inc., Monrovia, CA.

"The standard system for us would be our own humidity sensor, which feeds back information about whether or not the system should be on. If you're tying it into a whole building system, then the fogging system will just check with the building system to see whether or not the fog system should be on," says Mee.

There are also fogging systems that use compressed air and water. While slightly more expensive to operate than the water-only type, these systems offer smaller particle sizes than high-pressure water-only systems.

With compressed air and water fog humidification, the compressed air collides with the water inside special stainless steel nozzles. The dual-fluid stream accelerates through the nozzle and then further collides with an impact surface to make billions of fog particles, the majority of which are 1 micron or less.

Typical air and water pressures are 100 psi for air and 65 psi for water. A typical compressed air and water fog nozzle has an orifice diameter of between 75 and 100 thousandths of an inch. Com-pressed air and water fogging systems don't usually have clogging problems related to water supplies, and when used with good domestic water supplies require no additional water treatment.

Compressed air and water fogging systems are generally controlled by building automation systems (bas) through modulating analog signals, such as a 4-20mA-control signal. Typical turndowns are 50-100:1. Local digital controllers can also be utilized if a bas is not present.

Dan Reens, fogging systems product manager, Armstrong International, Three Rivers, MI, says the control system is something the contractor really needs to think about ahead of time. "Fogging systems provide adiabatic cooling as they place their fog into the airstream. This is a great benefit to this type of humidifier.

"However, if the control system for the duct or air handler cannot measure this evaporative cooling effect, many challenges can arise in obtaining proper performance from the fogging system."

Cleanliness and Cost Benefits

One of the biggest advantages to using a fogging system is cost. These systems do save energy over other humidification systems. As Mee notes, "The bottom line is that a fog system costs $75 for 1,000 hours of operation while electric steam costs $16,800. With natural gas steam, it's $5,000. Then we get down to other types of spraying systems, and it's $1,200 for ultrasonic and compressed air is $2,500. They all use more energy."

Another benefit is that fogging systems do not have a reserve tank to hold water, so there are few concerns about legionella and other contaminants. "Legionella have never been found in a fogging system," says Reens. "Because a compressed air/water fogger uses an air blast atomizing method, it obliterates the water droplets in the fog-generating process. Air/water velocities within the fogger orifice reach close to the speed of sound; then, after this enormous stress, the water particles are slammed into an impact surface called a resonator."

Additionally, when using the domestic water supply, antibacterial additives are brought in, such as chlorine, fluoride, and other agents normally found in public drinking water.

Finally, every fogging system purges itself to drain when not in use, so standing water is not left in the system to create bacterial growth environments.

When a water supply is hard or soft and contains a reasonable amount of mineral solids, the contractor must determine whether it warrants removal of the majority of the solids prior to fogging or after fogging. To remove them prior to fogging, an average-rated reverse-osmosis (RO) system is recommended, says Reens.

RO systems remove solids at the ionic level, which is required to remove minerals dissolved in a water supply. If, on the other hand, the water quality is good but some minimal dusting may be expected, it is possible to remove the dust through medium- to high-efficiency air filters located downstream of the fogging system.

(Note: These filters must be located well after the humidification chamber, and they should never be located immediately after the fogging chamber.)

Systems Can't Be Used Everywhere

While there are many advantages to fog humidification systems, there are some drawbacks. Namely, they can't be used everywhere. Mee says his company does not recommend that contractors try to bid a fogging job where there is less than 250 lb/hr of water, which is approximately a 300,000-Btu boiler.

"Otherwise, the first costs are just too high," says Mee. "You have to put in pumps and stainless steel lines sometimes. The hardware of making our system get to 1,000 psi makes it inefficient to just put one nozzle out there spraying. So I'd say there's a broad range of home-type applications and small commercial applications that wouldn't work."

Another point to take into consideration is the air speed in the ductwork. The system works best when air speeds are under 750 ft per min (fpm). There are two reasons:

First, the water needs to evaporate and with speeds over 750 fpm, whatever water is collecting on the mist eliminator, which will be drained away, will actually be pulled right off the pad and put back in the airstream as a huge droplet.

Second, there's a concern for duct cleanliness. These huge droplets can form pools, which could increase the chances for legionella growth.

Reens notes that fogging systems must be applied with the proper supports,

design, and controls in mind. "Installation consists of a single compressed air line and a single water line to each system. The pipe sizes an installer would expect to use would be between 1/2 and 2 inches for compressed air, and between 3/8 and 3/4 of an inch on water."

But there are no consumables with the fogging system (plastic tanks, elements, etc.) and only seasonal calibration is required. A simple 120-V, single-phase, 10-amp circuit is required for the electrical portion. As Reens says, "Generally, they are easy to install, operate, and maintain."

Sidebar: 'Generic' Software Offered for Hvacr

A self-described "generic" software system provider for the refrigeration and air conditioning industry, Mistral, is making its first foray into the U.S. market.

Established in 1984, Mistral software is said to be used by more than 65% of United Kingdom refrigeration and air conditioning contracting firms. Programs are distributed in more than 80 countries, according to the company.

One of the services is the "Coldwind" computer program to accurately calculate a cold room refrigeration load. According to the company, the program also provides a detailed presentation for customers. In general, the company claims its software helps eliminate mistakes, reduce staff costs, and meet quality assurance procedures. Further, it claims that the programs do more than just calculate figures quickly; they also help avoid non-competitive designs.

For more information, contact the U.S. distributor, Ablaze Heating & Cooling, 82074 Hwy. 395 N., Umatilla, OR 97882; 541-567-1049; ***www.mistral-ltd.com*** *(website).*

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